IS 14544 (1998): Leather safety footwear with direct moulded PVC soles [CHD 19: Footwear]

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भारतीय मानक

सीधे संचकित पोलीविनाईल क्लोराइड (पी वी सी) तले के साथ चमड़े के सुरक्षा जूते — विशिष्टि

Indian Standard

LEATHER SAFETY FOOTWEAR WITH DIRECT MOULDED POLYVINYL CHLORIDE (PVC) SOLE — SPECIFICATION

ICS 61.060; 83.080.20

BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

November 1998 **Price Group 6**

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Footwear Sectional Committee had been approved by the Chemical Division Council.

This standard covers leather safety boots and shoes with direct moulded polyvinyl chloride (PVC) soles used in the industry and with general purpose resistance to oils and chemicals. Leather safety footwear with direct moulded rubber soles have already been covered by a separate Indian Standard 'IS 11226 : 1993 Leather safety footwear having direct moulded rubber soles (*first revision*)'.

Safety boots and shoes with direct moulded (PVC) soles are used by various industries including oil fields for providing safety to the workers engaged therein. Such footwear with direct moulded soles are manufactured, as the name indicates, by the direct moulding process. When the moulding process is over and the footwear is taken out from the machine, the solidified sole material adheres firmly to the leather upper of the footwear.

In this standard requirements for boots and shoes having direct moulded PVC sole with oil and chemical resistance properties have also been laid down along with general purpose footwear. Keeping in view the limited resistance that a leather upper can provide to oil and chemicals, it is advisable not to use such footwear where the working surface is clogged with oil or chemicals that may come into continuous and direct contact with the leather upper, during working.

Composition of the Committee responsible for formulation of this standard is given in Annex F.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

LEATHER SAFETY FOOTWEAR WITH DIRECT MOULDED POLYVINYL CHLORIDE (PVC) SOLE — SPECIFICATION

1 SCOPE

This standard prescribes requirements, methods of sampling and tests for leather safety footwear having steel toe caps and with direct moulded soles of PVC as primary raw material.

2 REFERENCES

The Indian Standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this Indian Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Indian Standard are encouraged to investigate the possibility of applying the most recent editions of the Indian Standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 2050 shall apply.

4 TYPES

The leather safety footwear having direct moulded PVC soles shall be of the following three types depending on their design:

Type 1 — General purpose safety shoes.

Type 2 — Safety shoes with oil resistant soles.

Type 3 — Safety shoes with chemical resistant soles.

Each of the above types of footwear may be of the following designs:

Ankle Boots (*see* Fig. 1),
Jodhpuri Shoes (*see* Fig. 2), and
Oxford/Derby Shoes (*see* Fig. 3A and 3B).

However such footwear with modified design may also be made, as agreed to between the purchaser and the supplier.

5 REQUIREMENTS

5.1 All the types and designs of leather safety footwear shall be made from chrome tanned upper leather with cleated soles and heels with slip-resistant pattern by direct moulding process.

5.2 Materials

5.2.1 *Upper Leather*

For upper, full chrome leather conforming to IS 5677 shall be used.

5.2.1.1 Unless otherwise specified, the leather shall be black or brown and printed with pebble grain or any print as agreed to between the purchaser and the manufacturer.

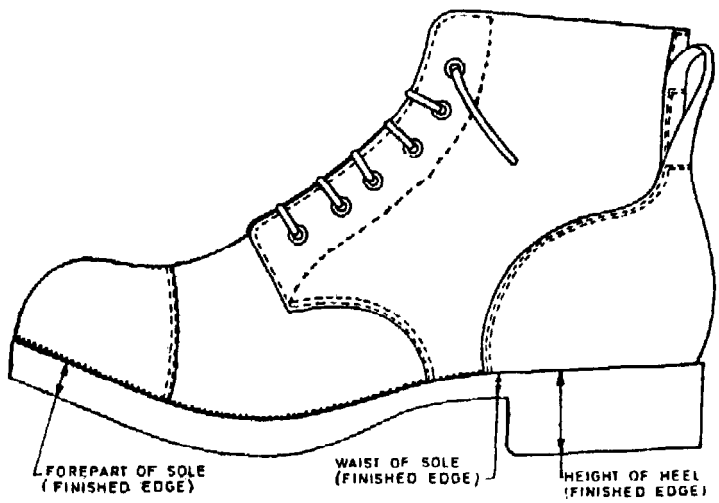


FIG. 1 ANKLE BOOT

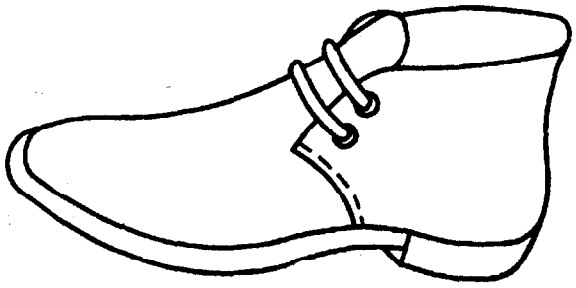
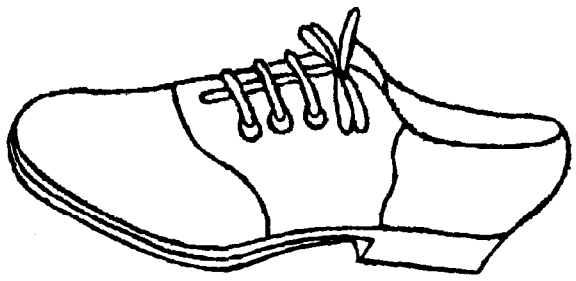
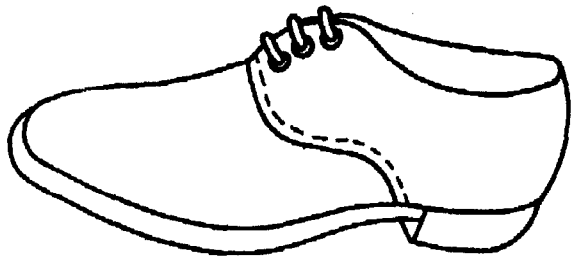


FIG. 2 JODHPURI SHOE



3A Oxford Shoe



3B Derby Shoe

FIG. 3 DIRECT MOULDED SHOES WITH PVC SOLE

5.2.2 *Insole Material*

Leather board conforming to IS 5867 shall be used. Chrome fibre board (reconstituted) may also be used if agreed to between the purchaser and the supplier.

5.2.3 *Stiffener*

Stiffener material shall be vegetable tanned sole leather splits (*see* Type 1 of IS 7554). Synthetic/ leather board stiffener material may also be used if agreed to between the purchaser and the supplier.

5.2.4 *Lining Material*

Lining leather conforming to Type 1 or Type 3 of IS 3840 shall be used.

NOTE — While checking the conformity of upper leather, leather for stiffener and lining leathers to the relevant standards mentioned under **5.2.1**, **5.2.3** and **5.2.4** respectively, the sampling shall be done in accordance with IS 5868.

5.2.5 *Threads*

Rot-proof cotton sewing threads conforming to variety No. 30 and 35 of IS 1720 and rot-proof linen or nylon thread complying with the requirements given in Annex B shall be used for stitching of upper. The colour of the thread used shall be as agreed to between the purchaser and the supplier.

5.2.6 *Grinderies*

5.2.6.1 *Lasting tacks*

Mild steel, rust proof, 12 ± 1 mm and 10 ± 1 mm long lasting tacks shall be used while lasting is done with the help of lasting tacks.

5.2.6.2 *Shanks*

Rust-proof shanks conforming to Type 1 of IS 10945 shall be used. Where the outer sole design provides equivalent bridging support, shanks may not be used.

5.2.6.3 *Eyelets*

Aluminium or steel eyelets of collar diameter 10 mm (*see* IS 5041) shall be used. Blind eyelets, hook or D-rings may also be used as agreed to between the purchaser and the supplier.

5.2.7 *Cotton* NEWAR

White, 19 ± 1 mm wide cotton *NEWAR* (*see* IS 1895) shall be used.

5.2.8 *Toe-Compound*

Gum glue or latex based compound shall be used.

5.2.9 *Laces*

Fabric laces of colour matching with colour of upper leather shall be provided for boots and shoes. The length of laces shall be 90 ± 5 cm and 60 ± 5 cm for boots and shoes respectively. If agreed to between the purchaser and the supplier nylon laces of equivalent grade may also be used (*see* IS 4778). Laces if coloured black, shall be free from sulphur dyes, when tested in accordance with the method prescribed in Annex C.

5.2.10 *Steel Toe Cap*

Steel toe caps conforming to Type 2 of IS 5852 shall be used.

5.2.11 *Sole and Heel*

Typical designs of moulded PVC sole and heel is given in Fig. 4 for guidance of the users. However the soles may be of any other design as agreed to between the purchaser and the supplier.

5.2.11.1 The direct moulded PVC sole and heel in the finished footwear shall have an anti-slip design, unless otherwise specified by the purchaser. It shall be free from visible defects, such as blow holes, cuts, cracks,

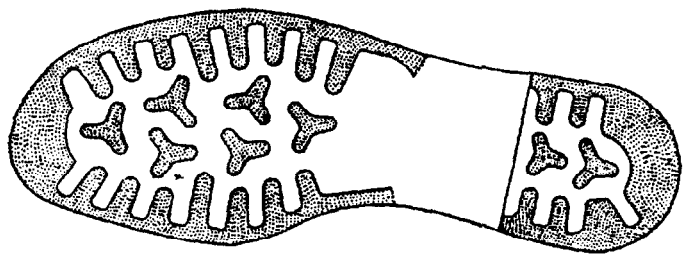


FIG. 4 DESIGN OF A DIRECT MOULDED SOLE AND HEEL

cavities, flash and spew. The direct moulded PVC soles of all the types shall also conform to the requirement given in Table 1.

5.2.11.2 In addition to **5.2.11.1** the direct moulded PVC soles of Type 2 in the finished footwear shall show a volume change of not more than +15 percent and −3 percent of the original value after immersion in iso-octane and toluene mixture (85:15) at 27 ± 2°C for 24 hours when tested according to the test method prescribed in Annex C of IS 13038.

5.2.11.3 In addition to **5.2.11.1** the direct moulded PVC soles of Type 3 in the finished footwear shall also conform to the requirements prescribed in Table 2.

5.2.11.4 All the three types of direct moulded PVC soles and heels on exposure at 70 ± 1°C for 148 hours under normal atmospheric pressure in an air circulating oven, shall not show any sign of hardening, cracking or tackiness.

Table 1 Requirements of Direct Moulded PVC Soles and Heels
(*Clause* 5.2.11.1)

Sl No.	Characteristic	Value Before Ageing	After Ageing at 100 ± 1°C for 24 h in Air Oven, *Max* (Percent Change from Original)	Method of Test, Ref to IS No.
(1)	(2)	(3)	(4)	(5)
i)	Relative density, *Max*	1.25	—	12240 (Part 3)
ii)	Hardness, IRHD	70 ± 5	± 5	12240 (Part 2)
iii)	Elongation at break, percent, *Min*	230	± 15	12240 (Part 6)
iv)	Tensile strength, MPa, *Min*	10	+ 15 − 0	do
v)	Flexing resistance (Cut growth):			
	a) at the end of 60 000 cycles	No crack	—	12240 (Part 7)
	b) at the end of 120 000 cycles, percent, *Max*	600		do

NOTES

1 If the heels are compounded from same mix of soles, then it may not be tested for Sl No. (iii) and (v).

2 Readings in the range of 30 to 95 (Shore durometer, Type A) are approximately the same as those in IRHD.

5.2.12 *Bottom Filling Material*

Seasoned wood or heel board filler shall be used. Other types of bottom filling material may also be used as agreed to between the purchaser and the supplier.

5.3 Components

Material and thickness requirements for various components shall be as given in Table 3.

Table 2 Requirements of PVC Soles and Heels with Chemical Resistant Properties
(*Clause* 5.2.11.3)

Sl No.	Characteristic	Percent Change from Original Value, *Max*	Method of Test, Ref to IS 13292
(1)	(2)	(3)	(4)
i)	Chemical resistance Effect of immersion at 27 ± 2°C for 72 hours separately in sulphuric acid solution (30 percent, *m/m*), hydrochloric acid solution (20 percent, *m/m*), and sodium hydroxide solution (20 percent, *m/m*) on the following characteristics:		Annex C
	a) Hardness (Shore A)	± 10	—
	b) Elongation at break	± 20	—
	c) Tensile strength	± 15	—
	d) Mass	± 2	—

5.4 Construction

The footwear shall be made by either direct moulding process (DMP) or direct injection process (DIP).

5.4.1 *Design*

Similar designs other than those illustrated in Fig. 1, 2 and 3 may be accepted if agreed to between the supplier and the purchaser.

NOTE — The illustrations are diagrammatic only and are not included to illustrate all details of designs.

5.4.2 All the components of the footwear shall be cut to the material and thickness requirements given in Table 3. All components shall be free from grain damages, flay cuts, wrinkles and other visual defects.

NOTE — For guidance to the manufacturers, correct locations/ type of material for various components are indicated in col 3 of Table 3.

5.4.2.1 All the upper components, specially vamp and tongue, shall be properly skived.

Table 3 Requirement of Components for Leather Safety Footwear Having Direct Moulded PVC Soles
(*Clauses* 5.3 *and* 5.4.2)

Sl No.	Component	Material	Thickness, *mm, Min*		
		Ankle Boots / Jodhpuri Shoes / Derby Shoes			
(1)	(2)	(3)	(4)	(5)	(6)
i)	Vamp	Prime part of full chrome upper leather (butt portion)	Lined: 1.3 Unlined: 1.6	1.3 1.6	1.3 1.6
ii)	Toe cap outside counter and jugloop	do	Lined: 1.3 Unlined: 1.6	— —	1.3 1.6
iii)	Quarter	Rest of the portion from upper leather except shanks	Lined: 1.3 Unlined: 1.6	1.3 1.6	1.3 1.6
iv)	Tongue	do	1.0	1.0	1.0
v)	Vamp lining	Lining leather to withstand vulcanizing temperature	0.8	0.8	0.8
vi)	Quarter lining	do	0.8	0.8	0.8
vii)	Tongue lining	do	0.6	0.6	0.6
viii)	Full sock	Pigmented splits	0.8	0.8	0.8
ix)	Insole	Leather Board/Chrome fibre board (reconstituted)	1.3	1.3	1.3
x)	Direct moulded rubber sole (finished):				
	a) at fore part with cleat	PVC	14.0	12.0	12.0
	b) at waist without cleat	do	7.0	5.0	5.0
	c) heel with cleat	do	27.0	25.0	25.0
	d) cleat	do	3.0	3.0	3.0
xi)	Heel filler	Pulp or fibre-board or light wood	10.0	8.0	8.0
xii)	Stiffener	Shoulder/belly of sole leather or celastic	1.0	1.0	1.0

NOTE — The thickness (not at skived portion) except full sock shall be checked before lasting of upper.

5.4.3 *Upper Closing for Ankle Boots*

5.4.3.1 All the upper components shall be stitched by lock stitching machine using thread of Variety No. 35 for counter, back of the quarters faces and sides of the quarter and toe cap. The thread mentioned may be substituted by linen threads of 3 ply, if required by the purchaser. Nylon thread of equivalent grade may also be used for this purpose as agreed to between the purchaser and the supplier.

5.4.3.2 The number of stitches shall be 20 to 25 per decimetre and in two rows, about 3 mm apart, on the toe caps and counters and two rows, about 5 mm apart on sides. The distance between the two rows of stitching at the quarter facing shall not exceed 2 mm. The first row of stitching shall be approximately 3 mm from edge of the quarter facing. All loose ends of threads shall be properly secured.

5.4.3.3 The back seam of the quarters shall be reinforced with a *NEWAR* as specified in **5.2.7**. The joined top of the quarter shall be strengthened by means of 25 ± 1 mm wide leather strap at the back.

5.4.3.4 The counter shall be turned over within 15 mm at the top of the leg so as to form a jugloop.

5.4.3.5 Unless otherwise agreed to between the purchaser and the supplier the tongue shall have full bellows and properly fitted so that wrinkles do not occur where it is joined to the vamp.

5.4.3.6 Six eyelets shall be fitted equidistantly in each face, each eyelet being properly clenched without any distortion.

5.4.4 *Upper Closing for Jodhpuri Shoes*

5.4.4.1 The upper shall be machine closed on lockstitch machine using cotton thread of Variety

No. 35 for sides and Variety No. 30 for other portions. The thread mentioned may be substituted by linen threads of 3 ply, if required by the purchaser.

5.4.4.2 The number of stitches shall be 20 to 25 per decimeter when stitched with either cotton or linen thread. There shall be two rows of stitches about 4 mm apart on sides of quarters. All other stitches shall be in single row.

5.4.4.3 Back seam stitches shall be reinforced with *NEWAR* tape and top of quarters shall be reinforced with lining leather. In absence of *NEWAR* back seam shall be stitched with zigzag stitching.

5.4.4.4 Two eyelets shall be fitted equidistantly in each face, each eyelet being properly clenched without any distortion.

5.4.5 *Upper Closing for Derby Shoes*

5.4.5.1 The upper shall be machine closed on lockstitch machine using cotton thread of Variety No. 35 for sides and Variety No. 30 for other portions. The thread mentioned may be substituted by linen threads of 3 ply, if required by the purchaser.

5.4.5.2 There shall be two rows of stitches on the toe cap about 4 mm apart, two rows on the facing about 1.5 mm apart and three rows on the sides about 3 mm apart. The remaining stitches shall be in single row. The number of stitches shall be 30 to 35 per decimeter when stitched with Variety No. 30 cotton thread

5.4.5.3 Three eyelets shall be fitted equidistantly in each face, each eyelet being properly clenched without any distortion. However, the number of eyelets as agreed to between the purchaser and the supplier may also be fitted in each face of the quarter.

5.4.6 *Lasting*

5.4.6.1 The upper shall be tack lasted with a clear lasting allowance of approximately 13 mm for Ankle boots and Jodhpuri shoes and 10 mm for Derby shoes all round.

5.4.6.2 The stiffener shall be included in the lasting. Prior to lasting steel toe cap shall be placed between leather toe cap and vamp lining to the exact shape and contour of the last. The steel toe cap shall have reinforced edges at the bottom to hold the insole.

5.4.6.3 Shanks shall be attached to the waist and under the heel.

5.4.6.4 The lasted margin shall be roughened properly all round and suitable adhesive applied uniformly. Fibre board, pulp board or light wood shall be used as heel filler before moulding of soles.

5.4.7 *Moulding of PVC Soles*

PVC soles shall then be moulded on the lasted upper by high pressure moulding machine. Care shall be taken to see that no air bubbles remain inside the PVC moulds and all portions are uniformly moulded. The moulding flash at the sole and heel shall be neatly trimmed.

5.4.7.1 A full sock shall be pasted down neatly on the insole of each footwear.

5.4.8 *Workmanship and Finish*

The footwear shall be free from injurious folds and wrinkles in the upper and trapped air, blisters, embedded foreign matter, excessive surface markings caused by dirt and damaged moulds in the soles.

5.4.8.1 The finish shall be in accordance with sound manufacturing practice. The footwear shall be properly finished and each pair shall be provided with one pair of fabric laces.

5.4.8.2 The leg height of the ankle boots shall be 150 ± 2 mm (both odds of a pair shall be equal in height) for size 8 and shall increase or decrease by 2 mm from size to size. The heel height shall be 27 ± 1 mm for all sizes.

5.4.8.3 The leg height of the Jodhpuri shoes shall be 100 ± 2 mm (both odds of a pair shall be equal in height) for size 8 and shall increase or decrease by 2 mm from size to size. The heel height shall be 25 ± 1 mm for all sizes.

5.4.8.4 Leg height of Derby shoes and footwear having design other than those given in Fig. 1, 2 and 3 shall be as agreed to between the purchaser and the supplier.

5.5 Mass

5.5.1 The mass of the ankle boots shall not exceed 1 400 g per pair of size 8. The mass of boots shall increase or decrease by 100 g per pair for bigger or smaller sizes respectively.

5.5.2 The mass of the Jodhpuri shoes shall not exceed 1 300 g per pair of size 8. The mass of such shoes shall increase or decrease by 100 g per pair for bigger or smaller sizes respectively.

5.5.3 The mass of the Derby shoes shall not exceed 1 200 g per pair of size 8. The mass of such shoes shall increase or decrease by 100 g per pair for bigger or smaller sizes respectively.

5.5.4 Mass of the footwear having design other than those given in Fig. 1, 2 and 3 shall be as agreed to between the purchaser and the supplier.

5.6 Performance Test

The safety boots and shoes when subjected to the impact test prescribed in Annex D shall withstand a blow of 14 kgf.m. Further the clearance inside the boots and shoes at the moment of impact when subjected to an impact test shall be at least 13.5 mm.

5.7 Adhesion Test on Moulded Bottoms

5.7.1 The adhesion test shall be carried out after a lapse of at least 72 hours on the completion of moulding or vulcanizing and after allowing the footwear to cool down to room temperature.

5.7.2 There shall be no visible parting of the bottoms from the upper at a load of 27 kg at toe and 35 kg at the sides and at heel seat of Ankle boot when tested for adhesion in accordance with Annex E. For Jodhpuri shoes, Oxford shoes and Derby shoes the load shall be 25 kg at toe and 30 kg at heel seat respectively.

6 SAMPLING

The scale of sampling of footwear, the method of their selection and the criteria for conformity shall be as prescribed in IS 2051.

7 MARKING AND PACKING

7.1 Marking

Sizes of the footwear and trade-mark, if any, shall be incorporated in the mould, so as to make them legible on the waist of the outer sole. Size and fitting number, and year of manufacture shall be marked on insole waist and also be legibly marked on the full sock.

7.1.1 The footwears shall also be marked with the following details:

a) Batch No.,
b) Month and year of manufacture, and
c) Any other statutory marking.

7.1.2 *BIS Certification Marking*

The product may also be marked with Standard Mark.

7.1.2.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7.2 Packing

Unless otherwise agreed to, the packing specified in **7.2.1** shall be followed.

7.2.1 The footwear shall be packed in wooden packing cases of adequate size so as not to spoil the shape of the footwear and lined with waterproof (bituminized kraft paper) packing paper.

7.2.2 The package shall be legibly marked with the following:

a) Name of the material;
b) Name of the manufacturer or his recognized trade-mark, if any;
c) Batch/Code No.; and
d) Size and quantity of pairs packed.

7.2.3 The packages shall be marked with green colour if safety footwear are of Type 2.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
1638 : 1969	Sizes and fittings of footwear (*first revision*)	4778 : 1982	Specification for cotton laces for footwear
1720 : 1978	Specification for cotton sewing thread	5041 : 1978	Specification for footwear and stationery eyelets (*first revision*)
1895 : 1982	Specification for cotton *NEWAR* (*first revision*)	5677 : 1986	Specification for shoe upper leathers for direct moulding process
2050 : 1991	Glossary of terms relating to footwear (*first revision*)	5852 : 1992	Protective steel toe caps for footwear (*second revision*)
2051 : 1976	Methods of sampling of footwear leather (*first revision*)	5867 : 1970	Specification for leather board
		5868 : 1983	Method of sampling for leather
3840 : 1996	Lining leather — Specification (*second revision*)	6368 : 1971	Method for sampling of rubber and rubber combination footwear

IS No.	*Title*	*IS No.*	*Title*
7554 : 1974	Specification for stiffeners	(Part 6) : 1988	Determination of tensile strength and elongation at break
10945 : 1984	Shanks for footwear	(Part 7) : 1988	Flexing test — Resistance to cut growth for soling material
12240	Method of test for polyvinyl chloride boots:	13038 : 1993	PVC boots, resistant to oils and fats — Specification (*first revision*)
(Part 2) : 1988	Determination of durometer hardness, Shore A	13292 : 1993	PVC boots, resistant to chemicals — Specification (*first revision*)
(Part 3) : 1988	Determination of relative density		

ANNEX B

(*Clause* 5.2.5)

REQUIREMENTS FOR LINEN THREAD

B-1 REQUIREMENTS

B-1.1 Requirements for different types of linen thread used for stitching of various upper components of direct moulded PVC sole ankle boots shall be as given in Table 4.

Table 4 Requirements for Linen Thread

Thread	Count (tex)	Plies	Direction of Twist	Minimum Breaking Load in kg on 50-cm Grip Length with the Rate of Traverse of Power-Actuated Grips Being 30 cm, *Min*
(1)	(2)	(3)	(4)	(5)
Linen	92 (or 18 s)	5	Z/S	11.0

ANNEX C

(*Clause* 5.2.9)

METHOD FOR DETECTION OF SULPHUR DYES IN BLACK COLOURED LACES

C-1 PROCEDURE

C-1.1 Boil the laces in alkaline hydrosulphite solution for one minute. If the shade is reduced to pale brown or yellow colour and on oxidation restored to the original colour, sulphur dyes shall be suspected to be present.

C-1.2 For confirmation, boil the laces in acidic stannous chloride solution in a test tube covered with a piece of filter paper moistened with lead acetate. A blackish/brown stain with metallic lustre confirms the presence of dyes.

ANNEX D

(*Clause* 5.6)

METHOD OF TEST FOR PERFORMANCE OF SAFETY FOOTWEAR

D-1 GENERAL

The impact test is carried out for determining the performance of safety boots reinforced with steel toe cap to withstand a blow of 14 kgf.m.

D-1.1 Test Specimen

D-1.1.1 The boot shall be tested only after 48 hours of moulding.

D-1.1.2 The test shall be made on the toe of the finished safety boots/shoes, sampled from each size of a lot.

D-1.1.3 *Pattern of Boot*

The test shall apply only to safety boots and shoes fitted with protective steel toe caps.

D-1.1.4 *Preparation of Test Specimen*

Prepare test specimen from the forepart of the footwear by cutting off the toe end from not more than 30 mm behind the rear edge of the toe cap. The upper and lining shall not be separated.

D-2 APPARATUS

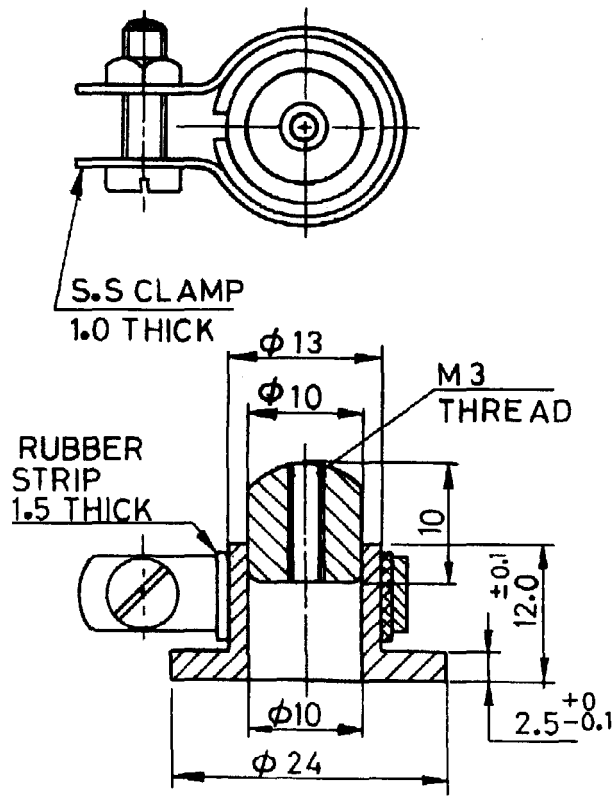
D-2.1 The testing apparatus shall be such that a 27.0 ± 0.2 kg load can be allowed to fall freely on vertical guides from various predetermined heights to strike a cylindrical mild steel plunger, 38 mm in diameter and 145 mm in length. Before carrying out any test, the test apparatus shall be checked for its ability to fall freely without any restriction up to the striking bar at the base of the apparatus. The plunger shall be freely supported in a vertical guide, and shall have attached to its lower end a horizontal mild steel bar 155 mm long, 38 mm wide and 10 mm thick. The bar (strike plate) shall be capable of resting across the toe cap with its front edge in line with the point of toe cap. The upper end of the plunger shall have a mild steel plate of 63 mm × 63 mm, screwed to it, and can be replaced when damaged. The above dimensions shall have a tolerance of ± 1 mm.

D-2.1.1 The base of the machine shall be solidly constructed of hard wood of not less than 75 mm thick. To this a metal block (50 mm thick) shall be bolted to support the steel plate on which the boot rests.

D-2.1.2 A capsule as illustrated in Fig. 5 suitable for measuring clearance inside the boot/shoe at the moment of impact shall be used. The capsule consists of a small duraluminium plunger which is depressed on impact into a brass cylinder. The metal clip shall be fastened around a rubber tubing which encases the cylinder and by tightening and loosening this clip the amount of friction between the cylinder and plunger can be varied. The cylinder wall shall be slotted to enable the clip to compress the cylinder on to the plunger. The clip shall be adjusted so that the movement between the two parts takes place at a load of less than 14.0 N, but no movement takes place at a load of 8.0 N.

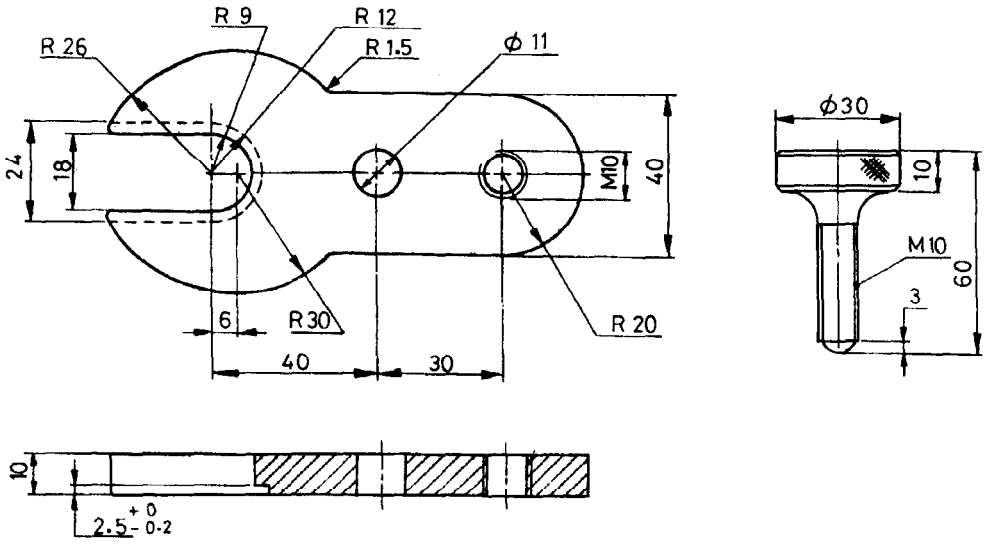
D-2.1.3 *Stabilizing Fork*

The details of a suitable stabilizing fork has been given in Fig. 6A and 6B.



All dimensions in millimetres.

FIG. 5 CAPSULE FOR MEASURING THE CLEARANCE AT THE MOMENT OF IMPACT



6A Stabilizing Fork

6B Adjusting Screw

All dimensions in millimetres.

FIG. 6 ATTACHMENTS FOR FIXING THE CAPSULE

D-3 PROCEDURE

D-3.1 Positioning

Place the capsule in the slot of the stabilisation fork and position it close to the rear end of the slot. Then place the test specimen on the clamping base so that the fork tips touch the fore end of its inn lining. The details of a suitable stabilizing fork has been given in Fig. 6A and 6B. Fix the stabilizing form by means of the clamping screw to rest on the insole. Now adjust both the clamping screw and the adjusting screw so that the stabilizing fork becomes more or less parallel to the base plate and the test piece is clamped firmly (*see* Fig. 8).

Now, place the clamping device of the impact testing equipment with the securedly clamped test piece under the vertical plunger of the performance testing apparatus (*see* Fig. 7 and Fig. 8).

Position the vertical plunger about 1 mm inside the rear edge of the steel toe-cap and under the striking bar so that the capsule is behind the centre line of the bar. The bar shall rest on the boot lengthwise roughly at right angles to the length of the test specimen.

D-3.2 Impact

Adjust the load to a height of 508 ± 5 mm above the top of the vertical plunger (*see* Fig. 8) and allow it to fall freely and strike the plunger. The impact should be of 14 kgf.m.

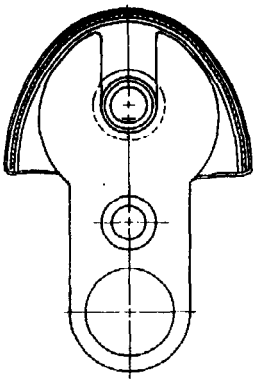


FIG. 7 PLACEMENT OF THE SAMPLE FOR DETERMINATION OF IMPACT VALUE

D-3.3 Measurement

Remove the capsule by unscrewing the adjusting screw (*see* Fig. 6B) and the clamping screw and measure the length from the top of the duraluminium plunger to the base of the capsule by means of a slide caliper fitted with a vernier, capable of measuring the value to the nearest 0.1 mm. This value is the clearance inside the boot/shoe at the moment of maximum depression.

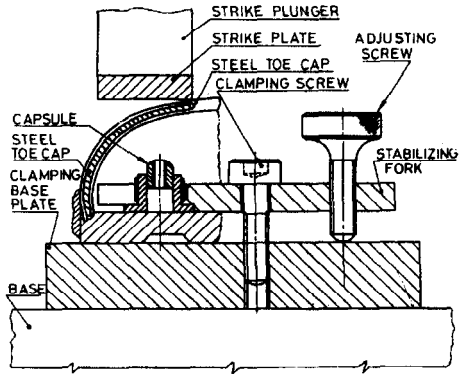


FIG. 8 POSITIONING AND CLAMPING OF THE FOREPART OF THE SAFETY FOOTWEAR

ANNEX E

(*Clause* 5.7.2)

METHOD OF TEST FOR ADHESION STRENGTH

E-1 ADHESION TEST ON VULCANIZED BOTTOM

E-1.1 Outline of the Method

The purpose of this test is to measure the adhesion strength between the stuck-on and moulded-on soles and the uppers to ensure satisfactory adhesive bond, in order to avoid premature failure of the footwear.

E-1.2 Conditioning

E-1.2.1 The properties of vulcanized/moulded rubber change continuously with time, particularly during first 24 to 48 hours from vulcanization/moulding.

E-1.2.2 Protect the samples of test pieces from light as completely as possible during the interval between vulcanization/moulding and testing.

E-1.2.3 Condition the samples at $27 \pm 2^{\circ}C$ for at least 12 hours and keep at this controlled temperature till tested.

E-1.3 Apparatus

E-1.3.1 *Adhesion Tester*

SATRA sole adhesion tester or its equivalent for measuring the toe and heel adhesion strength. The instrument consists of anvils, toe pieces with packing pieces provided to adjust the height of the anvil to suit the sole thickness and a load-measuring beam to record the load applied.

E-1.4 Procedure

E-1.4.1 *Adhesion of Toe*

Select the pressure block and the piece which conform to the shape of the toe of the footwear sampled for testing and attach it at the end of the load-measuring beam. Adjust the height of the anvil to suit the sole thickness, using the packing pieces provided, so that the forepart of the sole be horizontal or tends slightly downward towards the toe. Check the zero of the load gauge for correctness and avoid any error.

E-1.4.1.1 Place the footwear which last on the anvil and insert the toe piece of the instrument in the feather line groove between sole and upper. Grasp the footwear firmly and press down on the back of the last to increase the load steadily. Apply the load in such a manner so that the test is completed in about 5 seconds. Push the footwear hard against the pressure block (at the time of applying load) to prevent the toe of the footwear from slipping out of the toe piece of the instrument.

E-1.4.1.2 Read the load on the measuring beam of the instrument when the sole develops a tendency of separation from the upper. Record the reading as maximum value, as the load starts dropping after this value when further separation takes place. Examine and record the type of separation, whether tearing or failure in material (upper/sole) lack of adhesion to material, cohesive failure of the adhesive or incomplete coalescence of the adhesive.

E-1.4.2 *Adhesion at Heel*

Remove the anvil from the base of the instrument and fix up the stirrup attachment properly required for this test. Select the toe piece of the instrument which conforms to the curvature of the heel and attach it to the load beam.

E-1.4.2.1 Place the heel of the footwear in the stirrup, so that its rear touches the toe piece. Adjust the toe piece and level it with the groove between the heel and upper. Raise the footwear and add one or more stirrup packing pieces between the heel and stirrup till correct height is obtained. Insert the toe piece in the groove between the heel and upper. Apply load in such a manner that the test is completed in 5 seconds.

E-1.4.2.2 Read the load on the measuring beam of the instrument when the heel starts separating from the upper. Record the load and examine as described in **E-1.4.1.2**.

E-1.4.3 *Adhesion at Sides*

Follow the same procedure as described in **E-1.4.2** with a suitable toe piece which conforms to the curvature at sides, and carry out the test.

E-1.5 Reporting

Report the observations as follows and verify its compliance with **5.7.2**:

a) Adhesion value,
b) Type of test piece,
c) Duration of test,
d) Period of test, and
e) Pass/Type of failure.

ANNEX F

(Foreword)

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(*Continued on page* 12)

(*Continued from page* 11)

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